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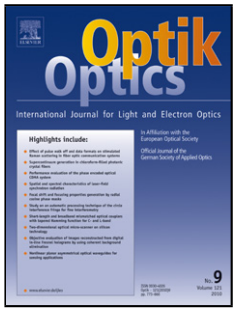

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Numerical simulation and experiment of high brightness tapered lasers

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Abstract: The optical properties of a tapered laser, which can be used to improve laser beam quality and generate a high brightness optical beam, are simulated and the tapered laser is fabricated. The beam quality, the index difference, and the index difference dependence on taper angle are studied. A tapered diode laser with a ridge waveguide is introduced and formed through etching the wafer with asymmetrical waveguide structure and double quantum wells. A high brightness power is achieved due to the combination of the ridge waveguide and the taper waveguide. In the experiment, the laser delivers 978nm, 8W CW with an 11.96A current. The beam quality factor M^2 in the vertical and lateral directions is measured at 1.42 and 2.21, respectively.

Keywords: high brightness, tapered laser, angular spectrum propagation

1 Introduction

With high conversion efficiency and minimization, the diode laser is widely used in scientific research and industrial applications. However, when operated in high power regimes, the diode laser suffers from relatively low beam quality of laser emission, which has undesirable effects for many experiments and practical applications, such as the pump source of Erbium Doped Fiber Amplifiers as the key elements of the networks. The main challenge currently is to improve the spatial quality of the beam to be closer to the diffraction limit. Many approaches have been proposed and applied, including various schemes of optical injection[1][2] and optical feedback[3][4], or integrated narrow master oscillator—tapered power amplifier configurations[5][6][7].
Here we apply a tapered laser cavity, which is described in M.T. Kelemen[8][9], to improve the quality. The angular spectrum propagation mothed is adopted to simulate the optical properties and the beam quality. A tapered laser is fabricated and a beam is achieved that has a quality near the diffraction limit and a power of 8W CW.

2 Model and the wafer structure

The tapered laser consists of a ridge waveguide and a taper waveguide, which are schematically shown in fig. 1. In our design, the length of the ridge and taper sections